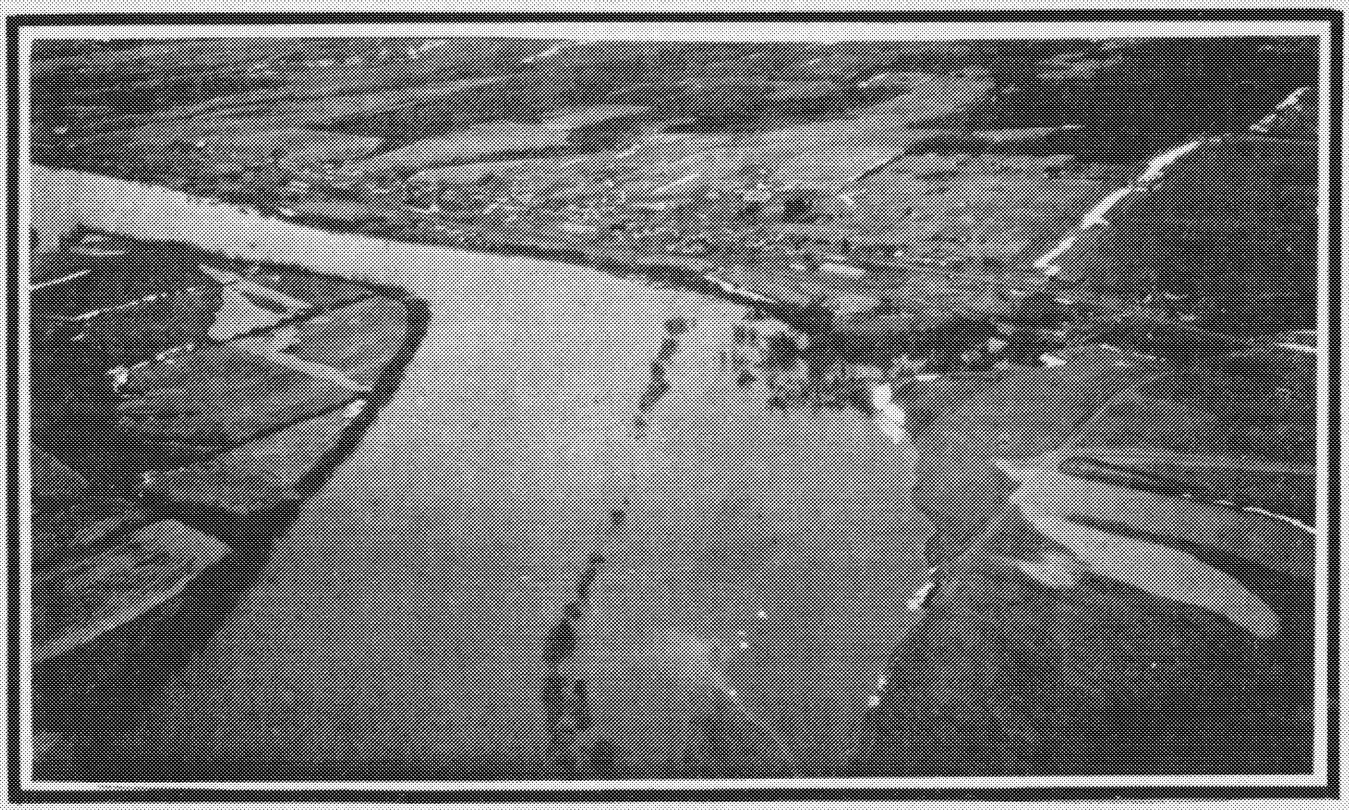
FLOOD PLAIN INFORMATION

ST. JOHN RIVER

GRAND ISLE MAINE



PREPARED BY THE DEPARTMENT OF THE ARMY, NEW ENGLAND DIVISION

CORPS OF ENGINEERS, WALTHAM, MASSACHUSETTS

SEPTEMBER 1978

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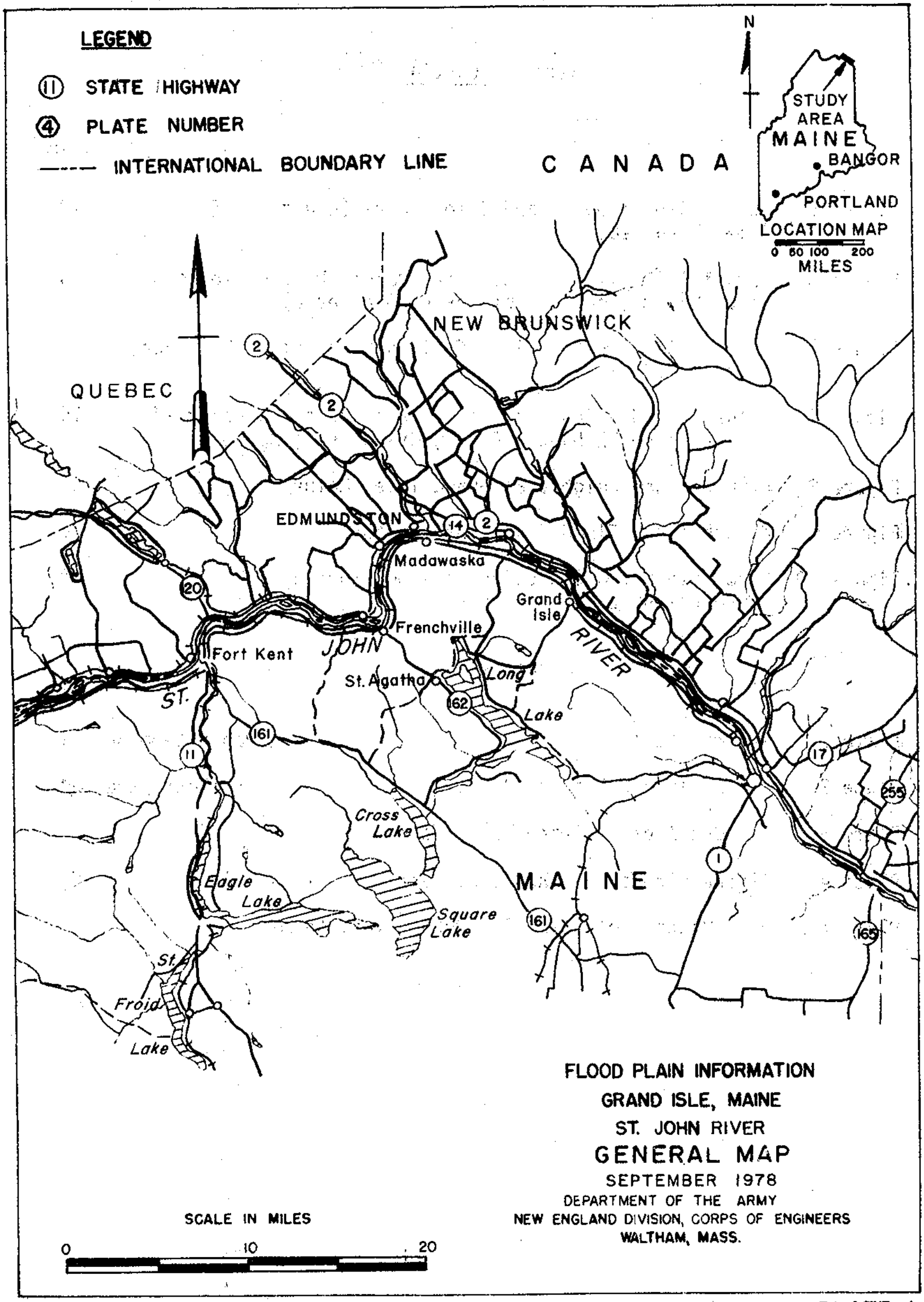


FLOOD PLAIN INFORMATION
GRAND ISLE, MAINE
ST. JOHN RIVER
GENERAL MAP
SEPTEMBER 1978
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE I

PREFACE

The portions of the Town of Grand Isle, Maine covered by this report are subject to flooding from the St. John River. The developments on the flood plains along this stream are primarily residential, farm, and commercial, and have been damaged by the floods of April 1973 and May 1974. The open spaces in the flood plains which may come under pressure for future development are extensive.

This report has been prepared because a knowledge of flood potential and flood hazards is important in land use planning and for management decisions concerning flood plain utilization. It includes a history of flooding in Grand Isle and identifies those areas that are subject to possible future floods. Special emphasis is given to these floods through maps, photographs and profiles. The report does not provide solutions to flood problems;. however, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development and thereby prevent intensification of other flood damage reduction techniques, such as works to modify flooding and adjustments, including flood proofing which might be embodied in an overall Flood Plain Management (FPM) program. Other FPM program studies--those of environmental attributes and the current and future land use role of the flood plains as part of its surroundings--would also profit from this information.

This report was prepared at the request of the Town of Grand Isle, with the endorsement of the State of Maine Water Resources Board by the Corps of Engineers, New England Division, under continuing authority provided in Section 206 of the 1960 Flood Control Act (Public Law 86-645) as amended.

Assistance and cooperation of the National Weather Service, U. S. Geological Survey, the Planning Board of Grand Isle, and private citizens in supplying useful data and photographs for the preparation of this report are appreciated.

Additional copies of this report can be obtained from the Planning Board in Grand Isle, Maine. The U.S. Army Corps of Engineers, New England Division, upon request, will provide technical assistance to planning agencies in the interpretation and use of the data presented as well as planning guidance and further assistance including the development of additional technical information.

BACKGROUND INFORMATION

Settlement

The town of Grand Isle, Maine is located in the northern part of the state near the U.S. - Canadian border. It is situated in the northeast corner of Aroostook County and has a land area of 36 square miles. The St. John River forms Grand Isle's northern border while the towns of Madawaska and Van Buren adjoin on its other sides.

Grand Isle was settled by Acadian French and incorporated in 1869. The people living in the area of Grand Isle were engaged primarily in the cultivation of the soil. The other industries of the time were maple sugar, fur commerce, and the export of lumber by water for the construction of English ships. Industrialization in the late 1800's opened several sawmills throughout the region. The present Fraser Companies, Ltd., which employs 1,000 employees in Madawaska, is an outgrowth of the era.

The twentieth century with its improved transportation systems has made potatoes the major cash crop. The changing nature of the potato industry, however, with its recent low prices and movement toward greater mechanization, has had a catastrophic impact on the community. There were 797 people living in Grand Isle in 1970 (22 people per square mile). Because of the bad economy the population has dropped and it is expected to drop further in the future if conditions to not improve.

The Stream and Its Valley

The St. John River Basin is located partly in northern Maine, and partly in the Provinces of New Brunswick and Quebec, Canada. The approximate drainage area of 21,360 square miles is one of the largest for any river on the Atlantic seaboard of North America. Approximately two-thirds are in Canada and one-third is in the United States, entirely in the State of Maine. This basin has common divides with the watersheds of the St. Lawrence River to the north and the Penobscot and St. Croix Rivers to the south.

The 365-mile long valley of the St. John River forms a broad uneven arc across the landscape of northern Maine, southeastern Quebec, and western New Brunswick. The headwater area of the Southwest Branch extends 50 miles southwest of the main stem of the St. John River. For about 100 miles the St. John River forms the international boundary. From its head the river curves northeastward to Madawaska, Maine, then southward past Woodstock, New Brunswick before turning east to Fredericton and finally southeast to its outlet at St. John, New Brunswick.

The St. John River rises in Little St. John Lake in the extreme southwestern corner of the basin, on the international boundary between Quebec and Maine. At the Southwest Branch the stream flows in a general northerly direction along the boundary for about 38 miles, and then through Maine about 12 miles to its confluence with Baker Branch. From this point, the main stem of the St. John River flows in a general northeasterly direction through Maine for a distance of about 95 miles to the mouth of the St. Francis River. It then flows easterly along the international boundary about 70 miles to Hamlin, Maine and then in a general southeasterly direction about 200 miles through New Brunswick past Fredericton to its mouth at St. John on the Bay of Fundy. The total fall in the river in Maine between its source at Little St. John Lake and Hamlin, Maine is about 1,159 feet, of which approximately 1,060 feet are in the upper 145 miles above its confluence with the St. Francis River.

The St. John River Basin has a humid continental climate with short, cool summers and long, cold winters. It is subject to both maritime and continental air masses whose influence varies with elevation and with interior or coastal location. The temperature over the watershed varies considerably and is often influenced in the southeast by prevailing winds off the ocean. In winters, sub-zero tempteratures occur approximately 50 times each year. Summers are cool, with average daily temperatures between 50°F and 70°F rising occasionally into the 90's. Extreme temperatures range from 40°F below zero in winter to over 100°F in summer. The average monthly and annual temperatures at several U.S. Weather Bureau stations in Maine are summarized in Table 1.

Developments in the Flood Plain

The flood plain along the St. John River is devoted to agricultural uses, mainly for the production of potatoes and hay. Usually, every spring, the lowlands flood, occurring more severely in the eastern part of town. Residential development along the river is limited to a few homes. The Bangor and Aroostook Railroad which runs along the riverbank, is subject to occasional flooding or depositing of ice.

SOURCES OF DATA AND RECORDS

The U.S. Geological Survey maintained a recording stream gage on the St. John River in Van Buren on the second pier from the Van Buren side of the International Bridge up until 1928. The USGS maintains a gage on the St. John River a quarter of a mile downstream from the Fish River, on the right bank, in Fort Kent.

Maps prepared for this report were based on U.S. Geological Survey quadrangle sheet titled, "Grand Isle, Maine."

TABLE 1

AVERAGE MONTHLY AND ANNUAL TEMPERATURES
St. John River Basin

Station	Caribou	Fort Kent	Houlton	Presque Isle
Years of Record				
	13	8	51	38
Elevation (ft., msl)				
	620	520	410	446
Month		Degrees Fahrenheit		
January	9.2	9.3	12.4	10.7
February	11.4	12.5	13.7	13.3
March	22.5	20.6	25.6	23.7
April	35.3	36.3	39.3	37.4
May	50.1	52.4	51.6	50.5
June	58.7	61.6	61.7	58.8
July	65.1	66.9	64.8	65.7
August	63.0	65.4	63.6	63.3
September	54.3	56.1	55.3	54.4
October	43.4	43.8	45.2	44.1
November	30.4	30.6	31.3	30.1
December	14.9	14.3	18.6	16.4
ANNUAL	38.2	39.2	40.5	39.0

FLOOD SITUATION

Flood Season and Characteristics

The threat of high stages on the St. John River at Fort Kent due to ice jams occurs annually during the spring break-up. It should be noted that ice jam events do not occur coincident with the peak annual discharge. Generally, ice jams can be expected to dislodge and pass downstream prior to the peak discharge and corresponding peak stage. The May 1, 1974 flood of record was an exception when the break-up of an upstream ice jam apparently resulted in a surge producing a high discharge and stage at Grand Isle.

Factors Affecting Flooding and Its Impact

Obstructions to floodflows - Natural obstructions to floodflows include trees, brush and other vegetation growing along the streambanks in floodway areas. Man-made encroachments on or over the stream such as dams, bridges and bridge abutments, road fills, buildings in close proximity to the river, and other similar constructions limits the floodway width and increase stage elevations and velocities in the main channel, and can create more extensive flooding than would otherwise occur.

During floods, trees, brush, and other vegetation growing in floodways impede floodflows, thus creating backwater and increased flood heights. Trees and other debris may be washed away and carried downstream to collect on bridges, dams and other obstructions to flow. As floodflow increases, masses of debris break loose and a wall of water and debris surges downstream until another obstruction is encountered. Debris may collect against a bridge or dam until the load exceeds its structural capacity and the structure is destroyed. The limited capacity of obstructive bridges or culverts, debris at the culvert mouth or a combination of these factors retard floodflows and result in flooding upstream, erosion around the culvert entrance and bridge approach embankments, and possible damage to the overlying roadbed.

In general, obstructions restrict floodflows and result in overbank flows and unpredictable areas of flooding, destruction of, or damage to bridges and culverts, and an increased velocity of flow immediately downstream. The only assumption that could be made in regard to debris accumulation is the fact that any low steel truss work under a bridge is subjected to plugging from ice or other floating materials and, therefore, the bridge opening can only be considered to be that area below low steel. Below low bridge chord, it is impossible to predict the degree or location of the accumulation of debris; therefore, for the purposes of this report, it was necessary to assume that there would be no accumulation of debris to clog any of the bridge openings in the development of the flood profiles.

Flood damage reduction measures - There exists at the present time no flood control projects on the St. John River. The Corps of Engineers has been authorized to study a proposal to construct multi-purpose dams and reservoirs on the St. John River at Dickey and Lincoln School, Maine. Located approximately 60 miles upstream from Grand Isle, the projects would primarily be a source of hydroelectric power but could also be used in flood storage capacity to prevent flood damages to Grand Isle and other downstream communities. Since 1936, the New England Division, Corps of Engineers, has been active in a program of investigating the possibility of constructing flood control dams in the various river basins in New England. The feasibility of the two dams mentioned above is being studied as a result of this program.

Flood warning and forecasting - The U.S. Department of Commerce, National Weather Service is responsible for forecasting high water on the nation's rivers and for issuing flood warnings for the protection of life and property. When the State Civil Defense Agency receives such information, it notifies the Aroostook County Civil Defense Headquarters where special radio equipment is located with direct lines to major surrounding communities. The local communities are alerted by telephone communication from this point. There is also a state police radio net which can receive timely warnings and information. The state police net is manned 24 hours per day while the county civil defense organization is manned during normal business hours. Local inhabitants, industry, business and others are alerted by telephone calls made by civil defense volunteers, the fire siren in the town and, if necessary, by messenger. The civil defense director has a Standard Operating Procedure for this operation.

Flood fighting and emergency evacuation plans - The civil defense director for the town has a formal flood fighting and emergency evacuation plan. This plan is incorporated into a Standard Operating Procedure which details the measures to be taken. People are alerted in the same manner as described above. The people on the local level are all volunteers.

Material storage on the flood plain - Streams with industrial developments along the bank could have quantities of floatable materials stored on flood plain lands, such as lumber, crates, large volume containers and storage tanks and containers which may be unrestricted and buoyant. During time of floods, these floatable materials may be carried away by floodflows causing serious damages to structures downstream and could clog bridge openings creating more hazardous flooding problems.

PAST FLOODS

Summary of Historical Floods

Little information is available on the magnitude and occurrences of floods that took place in Fort Kent before the establishment of a river gage in 1926 though it is known that major floods have occurred in the past.

Historical floods causing damages are reported to have occurred in 1933, 1961, 1969, 1971, 1973, 1974 and 1976. The USGS gage at Fort Kent is used as the basis for these figures. Before this time, the USGS gage at Van Vuren was used, until 1928, when the gage was discontinued.

Flood Records

Crest stages and discharges for known floods at the United States Coast and Geodetic gages on the St. John River at Van Buren and Fort Kent, Maine, in order of their magnitudes, are shown in Tables 2 and 3.

TABLE 2

FLOOD DISCHARGE DATA
St. John River at Van Buren, Maine

Date of Crest	Estimated Peak Discharge (cfs)	Stage (feet)
May 2, 1923	135,000	29.15
May 3, 4, 1911	134,000	34.90
May 13, 1909	134,000	34.90
April 29, 1913	119,000	26.90
May 8, 1928	118,000	26.70

TABLE 3

FLOOD DISCHARGE DATA
St. John River at Fort Kent, Maine

Date of Crest	Estimated Peak Discharge (cfs)	Stage (feet)
May 1, 1974	148,000	26.95
April 30, 1973	136,000	25.76
May 16, 1961	131,000	25.30
May 11, 1969	129,000	25.11
May 5, 1933	121,000	25.10
April 22, 1976	95,600	21.58

Flood Descriptions

May 1974 - The greatest flood of record at Fort Kent, located 30 miles upstream of Grand Isle occurred on May 1, 1974 when a peak stage of 515.8 feet above national geodetic vertical datum (ngvd, formerly mean sea level datum of 1929), corresponding to a flow of 148,000 cfs, was experienced at the USGS station and stage during this event was augmented by the breakup of a build-up of ice on the St. John River. The May 1, 1974 event resulted from rapid snowmelt and ice break-up, produced by daily maximum temperatures in the upper basin of about 60^{o}F on the 28th, 29th, and 30th of April, with above freezing nightly temperatures accompanied by about 0.5 inches of rain on the 29th and 30th of April.

April 1973 - The second greatest flood of record at Fort Kent occurred on the 30th of April 1973, when 2.0 inches of rainfall fell over the upper basin in a 48 hour period during the normal snowmelt season. A resulting peak stage and discharge of 514.7 feet ngvd and 136,000 cfs, respectively, were recorded on the St. John River at the Fort Kent USGS station. Other notable floods occurred in the springs of 1961, 1969, and 1933, when peaks of 25.10 feet ngvd or greater were recorded. (See Figure 1)

April 1976 - This flood was caused by a backup from an ice jam in Van Buren, just downstream from the Grand Isle town line. Damages from overflow occurred in some residential cellars. Ice two to three feet thick covered parts of the Bangor and Aroostook Railroad tracks. (See Figures 2, 3, 4)

FIGURE 1 - May 1, 1973 Aerial View of Flooding on St. John River, Grand Isle, Maine

FIGURE 2 - April 1976 Flood, Grand Isle, Maine
(Courtesy of James Beaulieu)

FIGURE 3 - April 1976 Flood, Grand Isle, Maine
(Courtesy of James Beaulieu)

FIGURE 4 - April 1976 Flood, Grand Isle, Maine
(Courtesy of James Beaulieu)

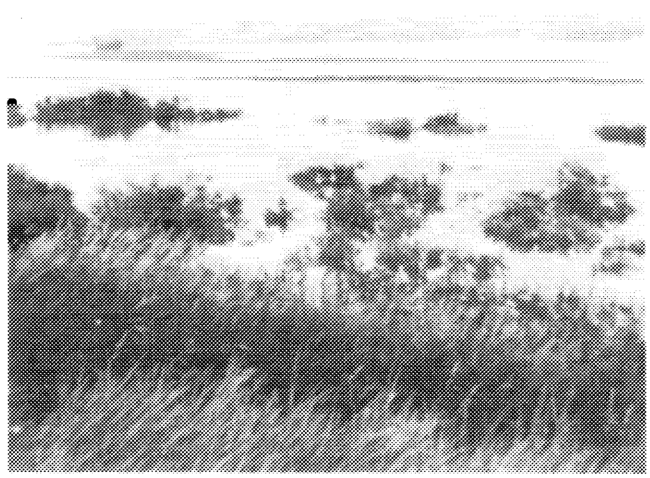


FIGURE 5 - August 1976 Flood, Grand Isle, Maine,
Potato Fields Under Water
(Courtesy of Gerard Ouellette)

August 1976 - Heavy rains from the remnants of hurricane "Belle" resulted in many acres of potatoes and hay being inundated and ruined. Water also filled some of the residential cellars. (See Figures 5 and 6)

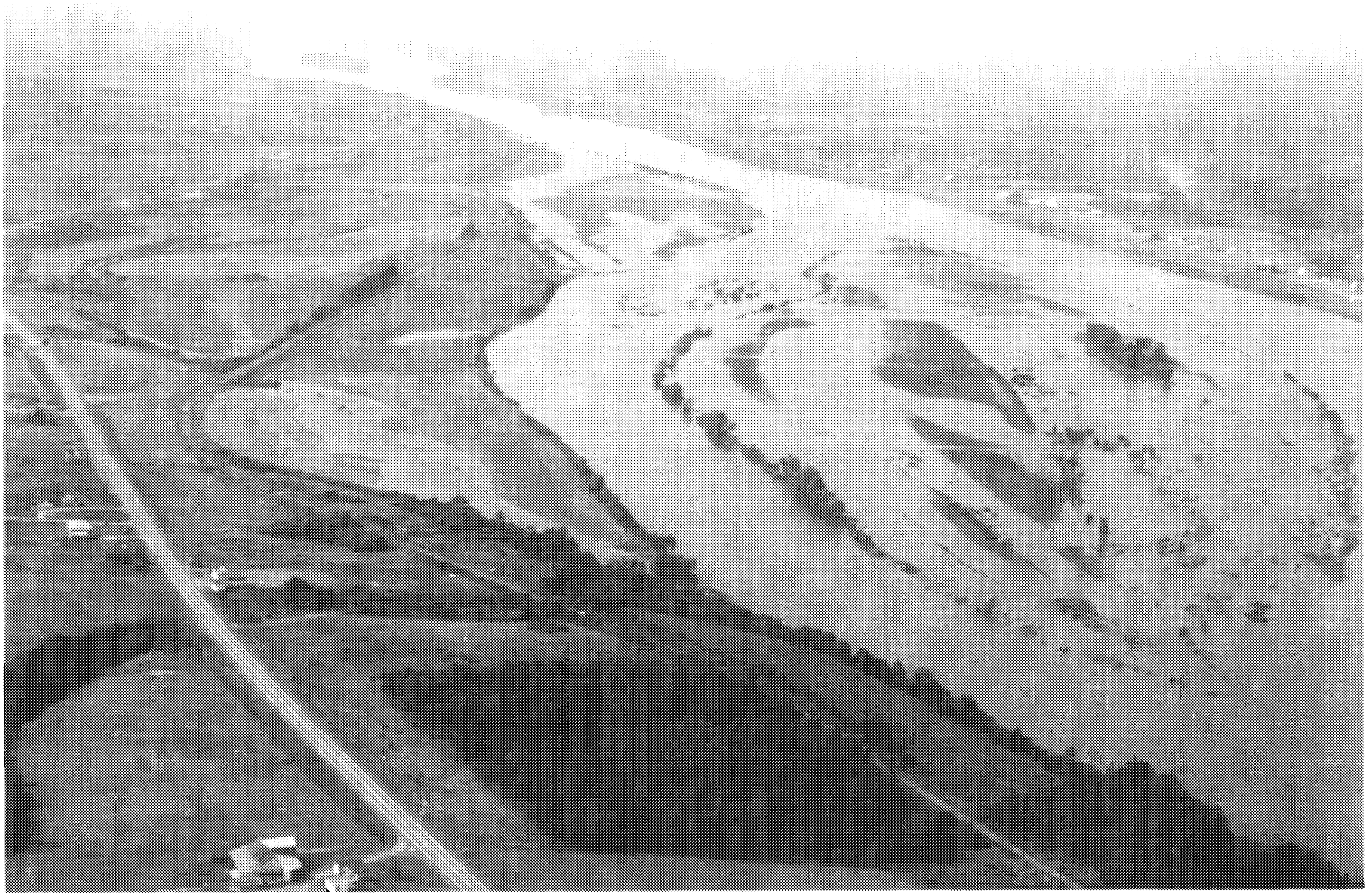


FIGURE 6 - August 1976, Aerial View of Flooding on St. John River, Grand Isle, Maine

FUTURE FLOODS

Floods of the same or larger magnitude as those that have occurred in the past could occur in the future. Larger floods have been experienced in the past on streams with similar geographical and physiographical characteristics as those found in the study area. Similar combinations of rainfall and runoff which caused these floods could occur in the study area. Therefore, to determine the flooding potential of the study area, it was necessary to consider storms and floods that have occurred in regions with like topography, watershed cover and physical characteristics. Discussion of the future floods in this report is limited to those that have been designated as the 100-year and the 500-year frequency floods. The 500-year flood represents a reasonable upper limit of expected flooding in the study area. The 100-year flood may reasonably be expected to occur more frequently although it will not be as severe as the 500-year flood.

Flood Magnitudes and Their Frequencies

The 100-year flood is defined as one that could be equalled or exceeded on the average once in 100 years. This does not mean that a flood of this magnitude must occur once and only once every 100 years, but rather that in any given year, there is a 1 percent chance of the 100-year flood occurring. The limits of this flood are used by Federal agencies, states, cities and towns as minimum criteria in establishing flood plain zoning. Looking at the concept of the 100-year flood in more familiar time intervals, consider its relationship to the human life expectancy of approximately 70 years. The probability that a 100-year flood will occur at a specific location in this time span is approximately 50 percent. Similarly, the probability that a 100-year flood will occur within a 30 year time span, a typical mortgage loan term, is about 25 percent. The peak flow of this flood was obtained from the discharge-frequency curve. For the St. John River the 100-year discharge was determined from statistical studies using the 50 year record of flood data from the USGS gage in Fort Kent. In a similar manner, the 500-year flood is defined as one that could be equalled or exceeded on the average once in 500 years. Thus, a 500-year flood would have a 0.2 percent chance of occurring in any given year.

A frequency curve of peak flows of the St. John River was constructed on the basis of available information and computed flows of floods up to the magnitude of the 500-year flood. The frequency curve thus derived, which is available on request, reflects the judgment of engineers who have studied the area and are familiar with the region. However, it must be regarded as approximate. Floods larger than the 500-year flood are possible, but the combinations of factors necessary to produce such large flows would be extremely rare. Discharge data for return frequencies of 10, 50, 100, and 500-year floods at Grand Isle are measured by the Fort Kent USGS gaging station.

It should be noted that the flood profiles and flooded areas shown on the plates included in this report are based on adopted values of flood discharges and stream channel and flood plain conditions as they existed at the time of the study. They may not, therefore, agree with reported high water marks from previous floods of an estimated magnitude. For example, existing bridges and highway embankments crossing flood plains have been assumed to remain intact whereas during previous floods they may have been destroyed or breached. In such cases, the computed flood elevations would differ from the observed flood elevations for floods of similar magnitude.

The 100-year and 500-year floods were determined by hydrologic studies based on engineering judgment and procedure. However, it is noted that future flood stage and discharge frequencies in the study area will depend partly on the unpredictable acts of man rather than the probability of meteorological events. Serious flooding may occur at any time due to the result of clogging with debris or collapse of any of the bridges. Encroachment or natural storage areas will increase flood discharges and stages due to the increased runoff rates from the developed areas, the loss of temporary ponding space, and the possible restriction of the floodway. The hydrologic information reported herein is considered representative under existing conditions in the study area and under reasonable future levels of development.

Hazards of Large Floods

The extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, rate of rise, and developments in the flood plain. A 100-year flood or 500-year flood on the St. John River would result in inundation of residential and agricultural sections in some parts of the study area. Deep flood water flowing at high velocity and carrying floating debris would create conditions hazardous to persons and vehicles attempting to cross flooded areas. In general, flood water three or more feet deep and flowing at a velocity of three or more feet per second could easily sweep an adult person off his feet, thus creating definite danger of injury or drowning. Rapidly rising and swiftly flowing flood water may trap persons in homes that are ultimately destroyed or in vehicles that are ultimately submerged or floated. Water lines can be ruptured by deposits of debris and the force of flooding waters, thus creating the possibility of contaminated domestic water supplies. Damaged sanitary sewer lines and sewage treatment plants could result in the pollution of flood waters creating health hazards. Isolation of areas by flood water could create hazards in terms of medical, fire or law enforcement emergencies.

Flooded Areas and Flood Damages - The areas in the community that would be flooded by the 500-year flood are shown on Plate 2 which is also an index map to the succeeding plates. Areas that would be flooded by the 100-year and 500-year floods are shown in detail on Plates 3 and 4. The actual limits of these overflow areas may vary somewhat from those shown on the maps because the 20 foot contour interval and scale of the maps do not permit precise plotting of the flooded area boundaries. These plates show the parts of the community that would be covered by the 100-year and 500-year floods during flood flows.

The areas that would be flooded include agricultural and residential sections and the associated streets, roads and public and private utilities in the community. Damage to these facilities could occur during floods.

Obstructions - During floods, debris collecting on bridges could decrease their carrying capacity and cause greater depths (backwater effect) upstream of the structures. Since the occurrence and amount of debris are indeterinate factors, only the physical characteristics of the structures were considered in preparing profiles of the 100-year and 500-year floods. Similarly, the maps of flooded areas show the backwater effect of obstructive bridges but do not reflect increased water surface elevation that could be caused by debris collecting against the structures.

Velocities of Flow - Water velocities during floods depend largely on the size and shape of the channel cross sections, conditions of the stream and the bed slope, all of which vary on different streams and at different locations on the same stream. Flood velocities in the study area vary considerably depending on the stream gradient, ranging from 3 to 9 feet per second in the channel and from 1 to 2 feet per second in the overbank areas. Velocities greater than three feet per second combined with depths of three feet or greater are considered dangerous. Water flowing at two feet per second or less would deposit debris and silt.

Rates of Rise and Duration of Flooding - The large drainage area of the St. John River at Fort Kent (5,690 square miles) plays a major role in flood rates and duration in the Grand Isle area. Because of the large size of the watershed, several days may pass before effects of heavy rains cause peak flows in the study reach. In the same manner, flood conditions may persist for as much as a week after peak flows occur, while lakes and large tracts of land in the upstream basin drain to normal levels.

Photographs, Future Flood Heights - The levels that the 100-year and 500-year floods are expected to reach at various locations along the Grand Isle study area are indicated on the following photographs, Figures 7 and 8.

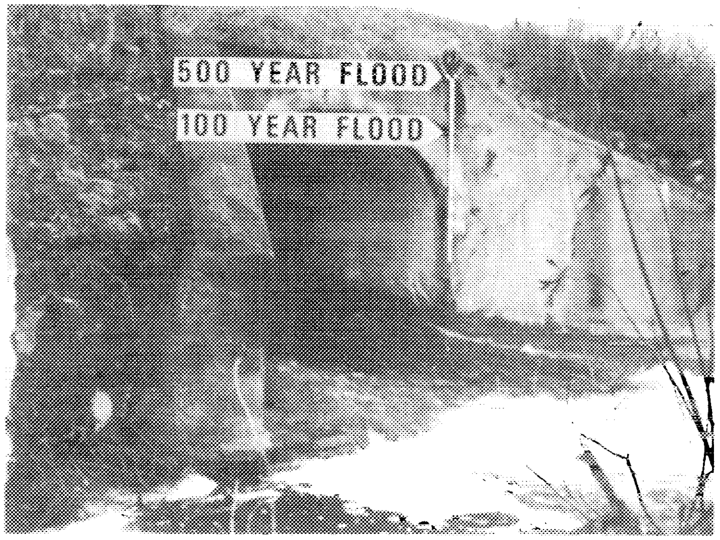


FIGURE 7 - Future Flood Heights at Bangor and Aroostook Railroad Culvert Over Thibadeau Brook, Grand Isle, Maine

FIGURE 8 - Future Flood Heights at Grand Isle, Maine

GUIDELINES FOR FLOOD PLAIN MANAGEMENT

Man has been building on and occupying the flood plains of rivers and streams since the arrival of pioneer settlers. The streams first provided transportation and water supply and later their gentle valley grades encouraged the construction of highways and railroads. Today uncontrolled growth of cities often results in unwise encroachment on the flood plains of local streams.

Through bitter experience, man has learned that floods periodically inundate portions of the flood plain, damaging property and often causing loss of life. This experience has led to a relatively new approach for reducing flood damages. Called "flood plain management," this approach consists of applying controls over the use of land lying adjacent to streams. Planned development and management of flood hazard areas can be accomplished by a variety of means.

Interpretation of Data

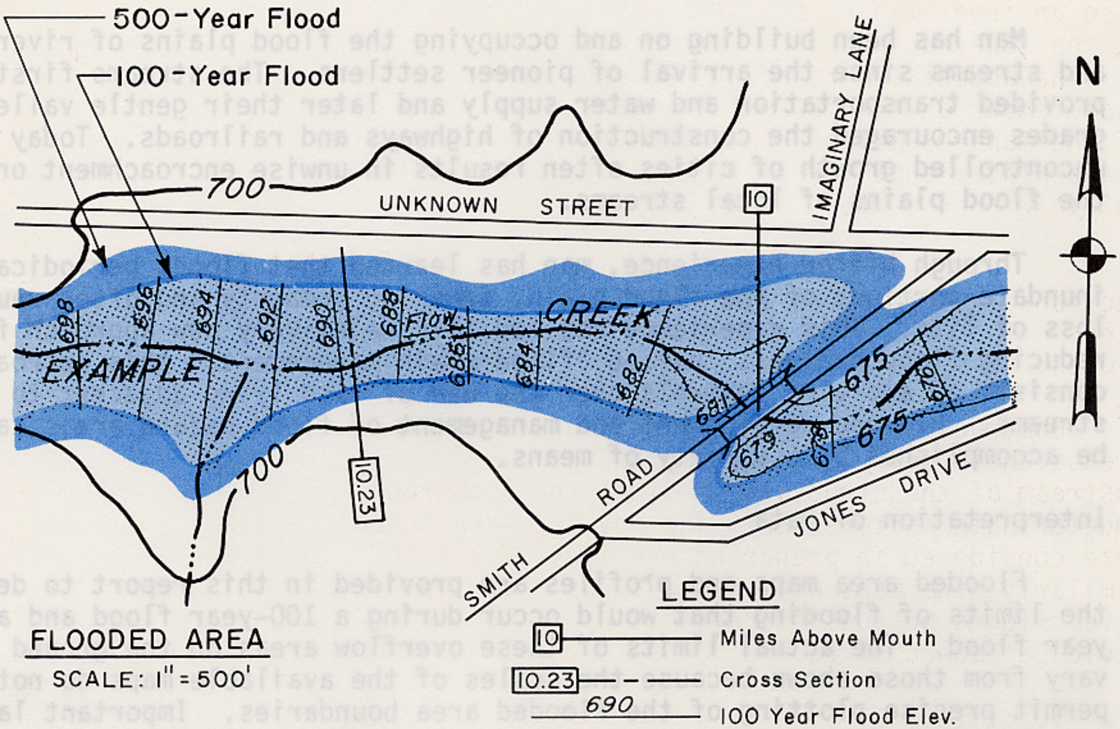
Flooded area maps and profiles are provided in this report to define the limits of flooding that would occur during a 100-year flood and a 500-year flood. The actual limits of these overflow areas on the ground will vary from those shown because the scales of the available maps do not permit precise plotting of the flooded area boundaries. Important land use decisions in specific areas should be verified by field surveys. Changes in the land use, drainage patterns, and structural occupancy of the flood plain may result in higher flood elevations than those shown.

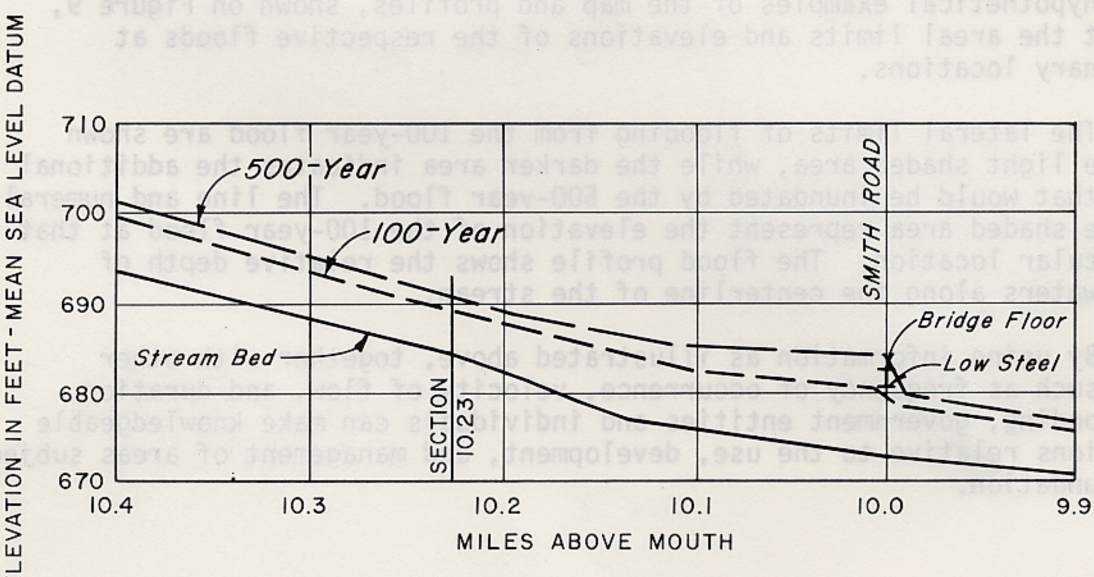
Hypothetical examples of the map and profiles, shown on Figure 9, depict the areal limits and elevations of the respective floods at imaginary locations.

The lateral limits of flooding from the 100-year flood are shown by the light shaded area, while the darker area indicates the additional land that would be inundated by the 500-year flood. The line and numeral in the shaded area represent the elevation of the 100-year flood at that particular location. The flood profile shows the relative depth of floodwaters along the centerline of the stream.

By using information as illustrated above, together with other data such as frequency of occurrence, velocity of flow, and duration of flooding, government entities and individuals can make knowledgeable decisions relative to the use, development, and management of areas subject to inundation.

HYPOTHETICAL FLOOD PLAIN INFORMATION





FLOOD PROFILE

FIGURE 9

Flood Plain Management Tools

The main purpose of this report is to provide guidance for intelligent land use in the river basin. This includes recognition of the existing flood hazards associated with streams in the area. Citizens of this and other watersheds have learned from bitter experience that the development of flood hazard areas should take place only with full knowledge of the risk and social cost involved. The following remarks concerning possible uses for the data presented herein are not intended to be all inclusive. They are meant to provide a cursory guide for utilizing the information on the flooding conditions in the river basin to the best advantage. The methods available for reducing flood losses can be subdivided into two general classifications, REGULATORY and NON-REGULATORY.

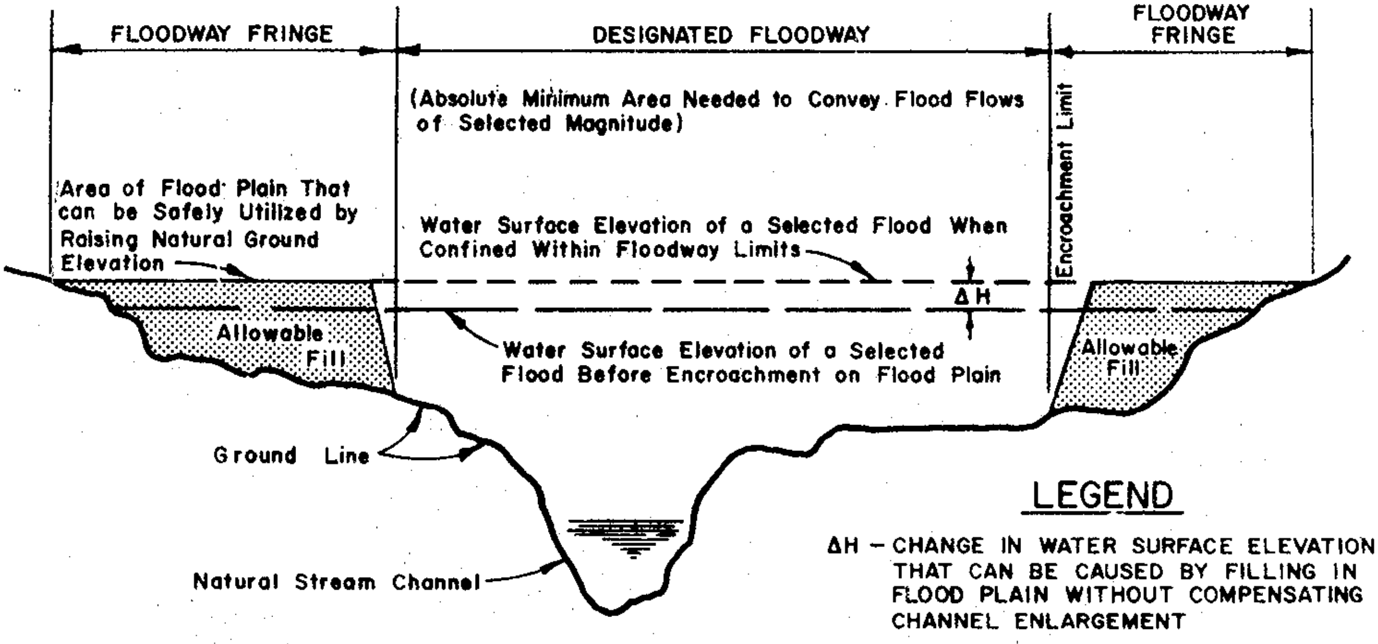
Regulatory Measures

Regulation of flood plain land use can substantially contribute to the reduction of future flood damages and risk, while contributing to other important objectives such as regional development and improvement or preservation of environmental attributes. (Of course, use here of the word "regulation" is not meant to imply nonuse of flood plain lands or any type of inequitable treatment of present or future land owners.)

Federal agencies do not have the authority to regulate flood plain development. This authority was assigned to the states (and their political subdivisions) in the tenth amendment to the U.S. Constitution and has never been delegated to the Federal Government. Consequently, it is local government bodies utilizing available state legislation that have to assume the day-to-day responsibility for guiding development in flood prone areas.

The principal regulatory devices used at local governmental levels include zoning ordinances, subdivision regulations, and building and health codes. The following is a discussion of these four types of regulations.

a. <u>Flood plain zoning ordinances</u> are usually "superimposed" on existing zoning ordinances. They may be used to implement broader land use plans and to reduce future flood losses by stipulating the type of building development permitted in flood prone areas. They can also be used to limit flood plain development by establishing flood plain encroachment limits. These regulations should exclude obstructions from flooding areas which adversely affect flood heights and allocate the flood plain to uses consistent with the degree of the flood threat. Floodways can be established along modified (enlarged, straightened) or natural stream channels. See the GLOSSARY OF TERMS for a definition of the terms floodway and encroachment limits. The floodway and encroachment limit concepts are also illustrated on Figure 10.



FLOODWAY FRINGE

Suggested Uses

Uses permitted in the floodway area.
Residential, Commercial, Industrial, Public & other development with floodwater entry points at or above design elevation for encroachment.

Uses Not Appropriate

Hospitals & Nursing Homes
Boarding Schools & Orphanages
Sanitariums
Detention Facilities
Refuge Center
Permanent Storage of Materials or Equipment (Emergency Equipment)

FLOODWAY AREA

Suggested Uses

Farms, Truck Gardens & Nurseries
Livestock & Other Agricultural Uses.
Non-obstructive Structures
Parking Lots, Playgrounds & Parks
Golf Course & Open Recreation
Preserves & Reservations.

Uses Not Appropriate

Land Fills & Obstructive Structures
Floatable Storage
Disposal of Garbage
Rubbish, Trash or Offal
All uses precluded from floodway fringe area.

FIGURE 10 – FLOOD PLAIN CROSS SECTION SHOWING FLOODWAY & ENCROACHMENT LIMIT CONCEPTS

b. Subdivision control ordinances may also be effective tools for flood plain building control. Subdivision control relates to the way in which land is divided and made ready for building development. For example, a city may control the subdivision of land within its jurisdiction by requiring that a large percentage of the minimum lot area of a subdivision be a designated height above an adopted floodwater elevation as a requisite for plat approval. Unlike zoning ordinances, which extend only to a city's limits, cities have some control over subdivision development in areas within their extraterritorial jurisdiction.

c. Building codes set forth standards of construction for the purposes of protecting health, safety, and general welfare of the public. Building codes may be written to set minimum standards for water (flood) proofing of structures, for establishing minimum first floor elevations consistent with potential flood occurrence, and requirements for material strength and proper anchorage.

d. Health codes can serve as a control over the use of flood plains for waste disposal and the construction of water and sewage treatment facilities that may create health problems during floods.

Nonregulatory Measures

Other methods that can be used to reduce flood damage losses include:

a. Structural measures can be used to reduce flood heights (channel modifications, dams) or provide a barrier between floodwaters and development (levees, dikes).

b. Fee purchase of lands for open space uses. Many grant and loan programs are available to local governments through the Department of Housing and Urban Development and other federal agencies for preserving flood plain lands as green belts, development of these areas for parks, nature trails, etc.

c. Acquisition of flooding easements. Purchase of less than fee interest in flood prone land is another approach to controlling development.

d. Flood proofing by elevating structures, water proofing, or filling of low areas for building sites. Some buildings can be raised in place up to a reasonable limit to prevent flood damages. Other structures can be made to withstand flood velocities and depths through the use of bulkheads, watertight openings, floation anchors, plumbing cutoff valves, and structural reinforcements. Structures can be built in flood plain fringe areas at elevations above a selected flood magnitude. However, this should be done only in connection with an established floodway width or encroachment limits to eliminate obstructions that would raise upstream flood stages.

e. Flood insurance can now be made available through the Department of Housing and Urban Development to communities that adopt appropriate flood plain regulations. Flood insurance does not reduce flooding or flooding caused damages, but reduces the risk of large economic losses by individual flood victims.

f. Development policies in regard to extending public services. "Flood conscious" governmental policies that limit or discourage the extension of public roads, utilities and other services into flood prone areas can play an important role in encouraging prudent flood plain use. Private developments usually depend on the extension of public services. By avoiding the extension of such services into flood hazard areas, local government and private utility companies can encourage the occupancy of safer, and in the long run, cheaper flood free areas.

Very little building is carried on without outside financing. Therefore, lending institutions, both Federal and private, are in a position to exercise control over flood plain development by denying mortgage guarantees or funds to subdivision or individual builders for projects that will eventually become "flood problems."

GLOSSARY OF TERMS

BACKWATER - The resulting high water surface in a given stream due to a downstream obstruction or high stages in an intersecting stream.

ENCROACHMENT LIMITS - A limit of obstruction to flood flows. They are normally established on the ground through the use of markers. These encroachment "lines" are roughly parallel to a stream but do not have to be equidistant from the centerline of a stream channel on each bank. Encroachment lines are established by assuming that the area landward (outside) of the lines will be ultimately developed in such a way that it will not be available to convey flood flows.

FLOOD - An overflow of water onto lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: the inundation of land is temporary; and the land is adjacent to or inundated by overflow from a river, stream, ocean, lake or other body of standing water.

Normally a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of the water surface, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land area, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of groundwater coincident with increased streamflow, and other problems.

FLOODWAY - a. Natural floodway. The channel of a watercourse and those portions of the adjoining flood plain which are reasonably required to carry and discharge the floodwaters of a selected probability-of-occurrence flood. b. Designated floodway. The channel of a watercourse and that portion of the adjoining flood plain required to provide for the passage of a selected flood with an insignificant increase in flood stage above that of natural conditions. Normally, the 100-year flood (one that has a 1 percent chance of occurrence in any given year) should be considered as the selected flood. An "insignificant increase" is normally considered to be no greater than 1 foot unless a smaller increase is established by State or local regulation.

FLOOD CREST - The maximum stage or elevation reached by the waters at a given location during any flood event.

FLOOD PLAIN - The areas adjoining a river, stream, watercourse, ocean, lake, or other body of standing water that have been or may be covered by floodwaters.

FLOOD PROFILE - A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

FLOOD STAGE - The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which elevation is measured. This is also referred to as critical stage.

HURRICANE - An intense cyclonic windstorm of tropical origin in which winds tend to spiral inward in a counterclockwise direction toward a core of low pressure with maximum surface wind velocities that equal or exceed 75 miles per hour (65 knots) for several minutes or longer at some points. Tropical storm is the term applied if maximum winds are less than 75 miles per hour.

HYDROGRAPH - A graph showing flow values, usually measured in cubic feet per second, versus time at a given point. The area under the curve indicates the total volume of flow. Also, a graph showing the stage in feet against time at a given point and the rate of rise and duration above flood stage.

LEFT BANK - The bank on the left side of a river, stream, or watercourse looking downstream.

LOW BANK - The lower of the two banks of a river, stream, or watercourse designated as left or right looking downstream.

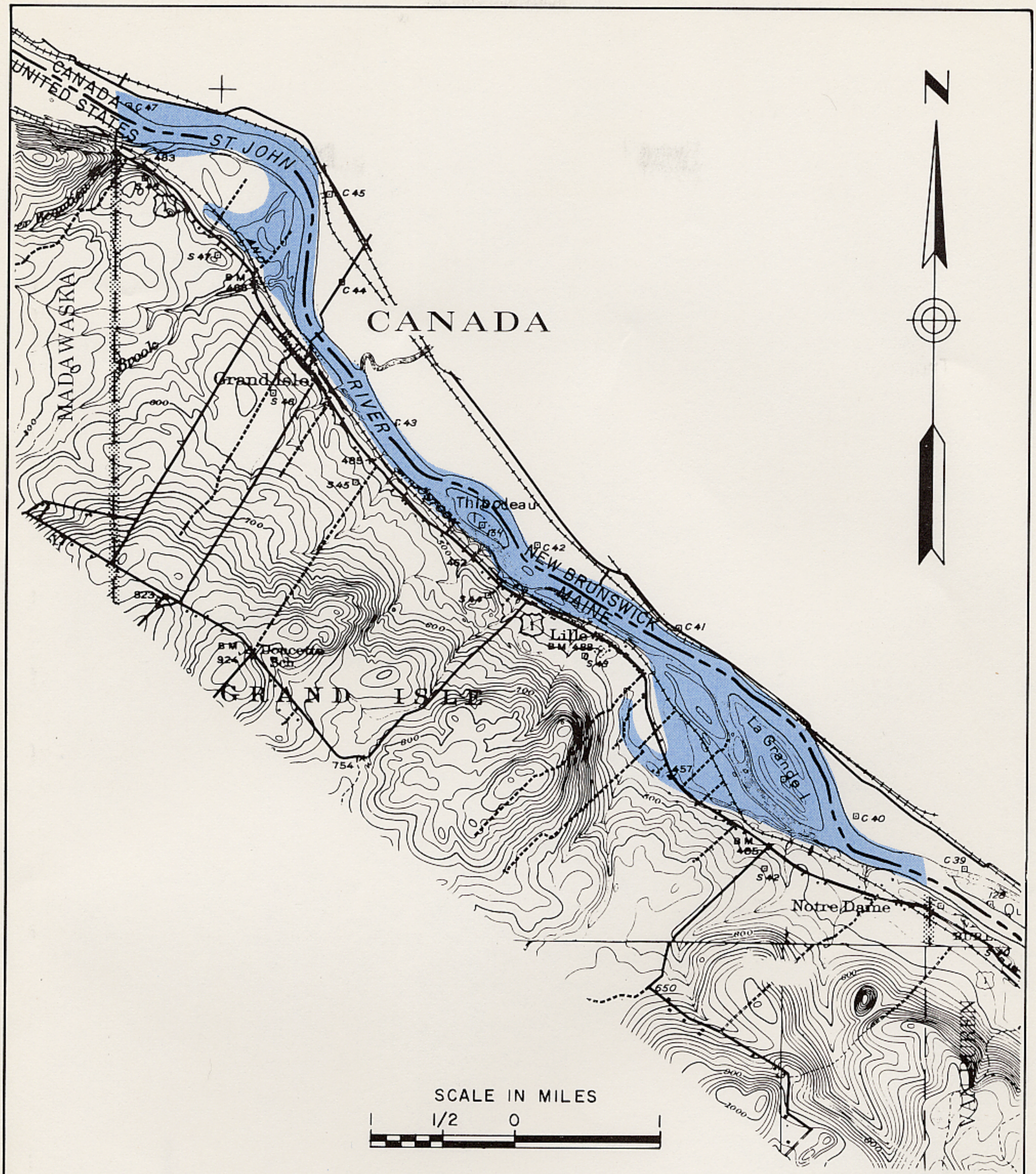
RATING CURVE - A graph or plot of discharge versus gage height at a given location with a given cross section.

RIGHT BANK - The bank on the right side of a river, stream, or watercourse looking downstream.

UNDERCLEARANCE ELEVATION - The elevation at the top of the opening of a bridge, culvert, or other structure through which water may flow along a watercourse. This is referred to as "low steel" in some regions.

100-YEAR FLOOD - The 100-Year Flood is the flood having an average frequency of occurrence of once in 100 years, although it can occur in any year. It is sometimes known as the Intermediate Regional Flood and has been defined as a flood that has a one percent chance of occurring in any one year.

500-YEAR FLOOD - The 500-Year Flood is defined as a major flood that has an average frequency of occurrence of once in 500 years, although it could occur in any year; or a flood that has a 0.2 percent chance of occurring in any one year.



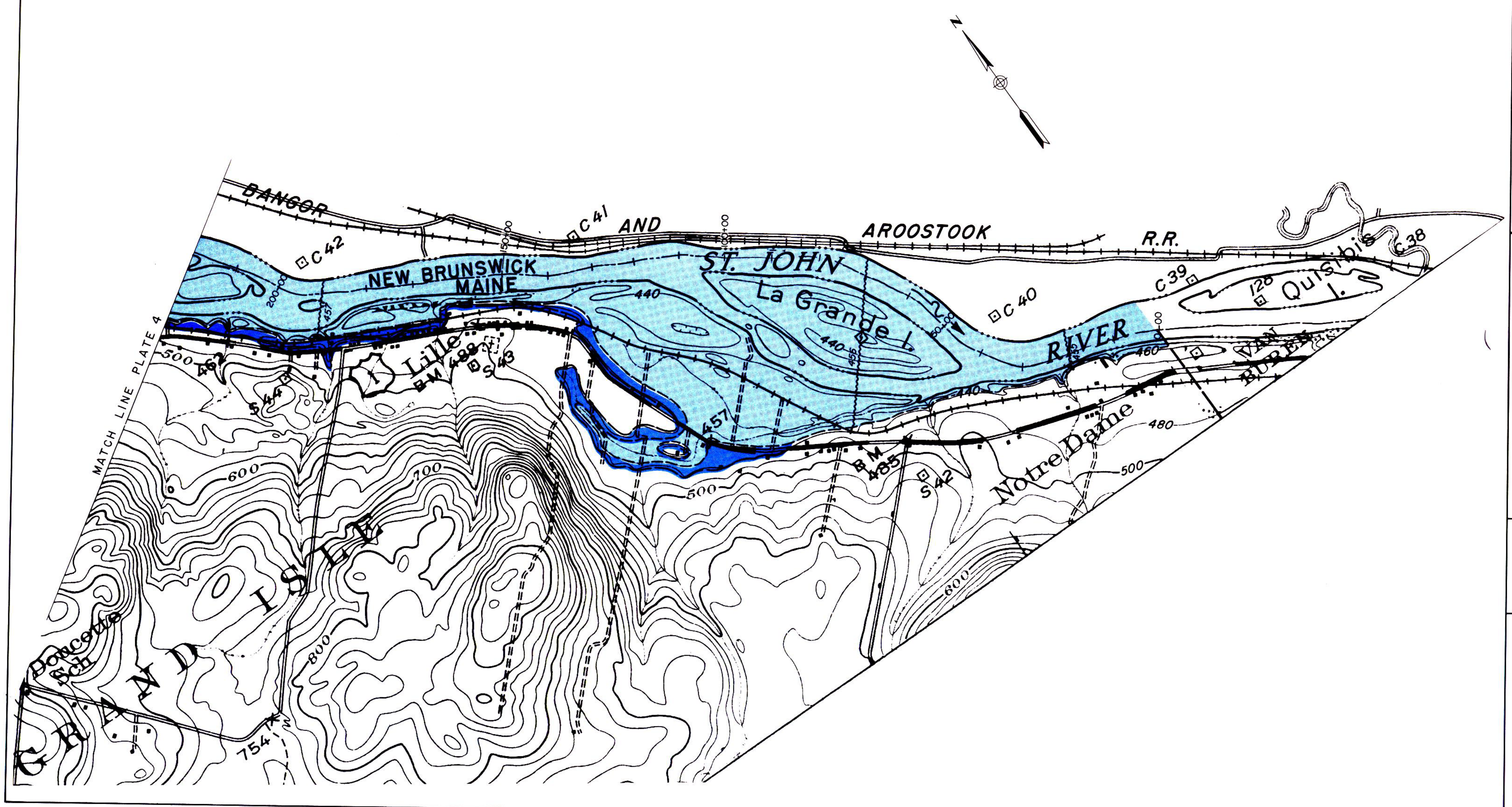
FLOOD PLAIN INFORMATION
ST. JOHN RIVER
GRAND ISLE, MAINE

INDEX MAP-FLOODED AREAS

SEPTEMBER 1978

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE 2



LEGEND

OVERFLOW LIMITS

100 Year Flood

500 Year Flood

480 GROUND ELEVATION IN FEET (U.S.C. & G.S.) SEA LEVEL DATUM

TOWN LINE

INTERNATIONAL BOUNDARY LINE

456 100 YEAR FLOOD ELEVATION

NOTES:

1. MAP BASED ON U.S.G.S. QUADRANGLE, GRAND ISLE, MAINE, DATED 1940, REPRINTED 1947. MINOR ADDITIONS AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS.
2. LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.
3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 20 FT.

SCALE IN FEET

1000 500 0 1000 2000 3000

FLOOD PLAIN INFORMATION

ST. JOHN RIVER

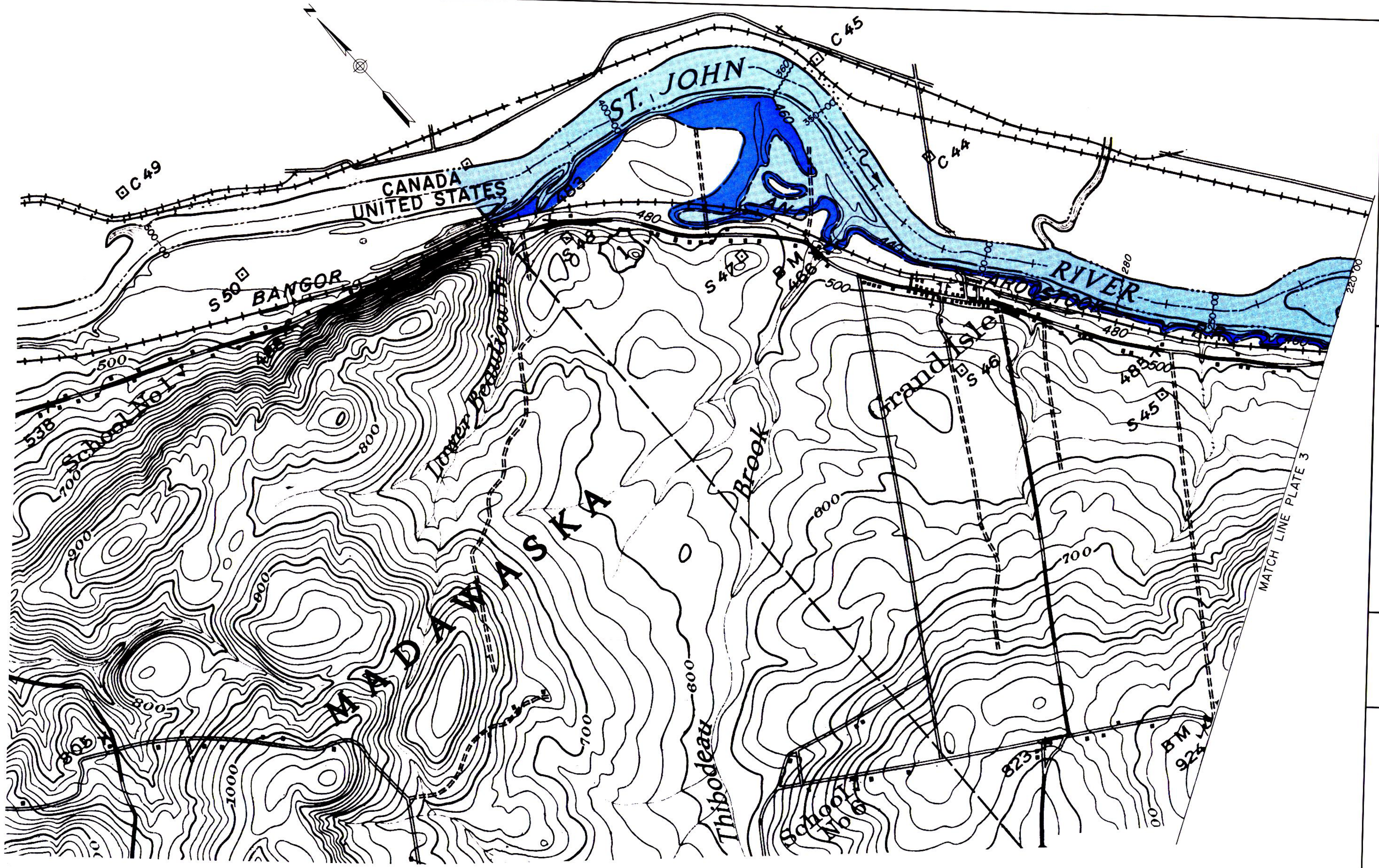
GRAND ISLE, MAINE

FLOODED AREAS

SEPTEMBER 1978

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE 3



LEGEND

OVERFLOW LIMITS

100 Year Flood

500 Year Flood

500 GROUND ELEVATION IN FEET (U.S.C. & G.S.) SEA LEVEL DATUM

TOWN LINE

INTERNATIONAL BOUNDARY LINE

360 100 YEAR FLOOD ELEVATION

NOTES:

1. MAP BASED ON U.S.G.S. QUADRANGLE, GRAND ISLE, MAINE, DATED 1940, REPRINTED 1947. MINOR ADDITIONS AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS.
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SCALE IN FEET

1000 500 0 1000 2000 3000

FLOOD PLAIN INFORMATION

ST. JOHN RIVER

GRAND ISLE, MAINE

FLOODED AREAS

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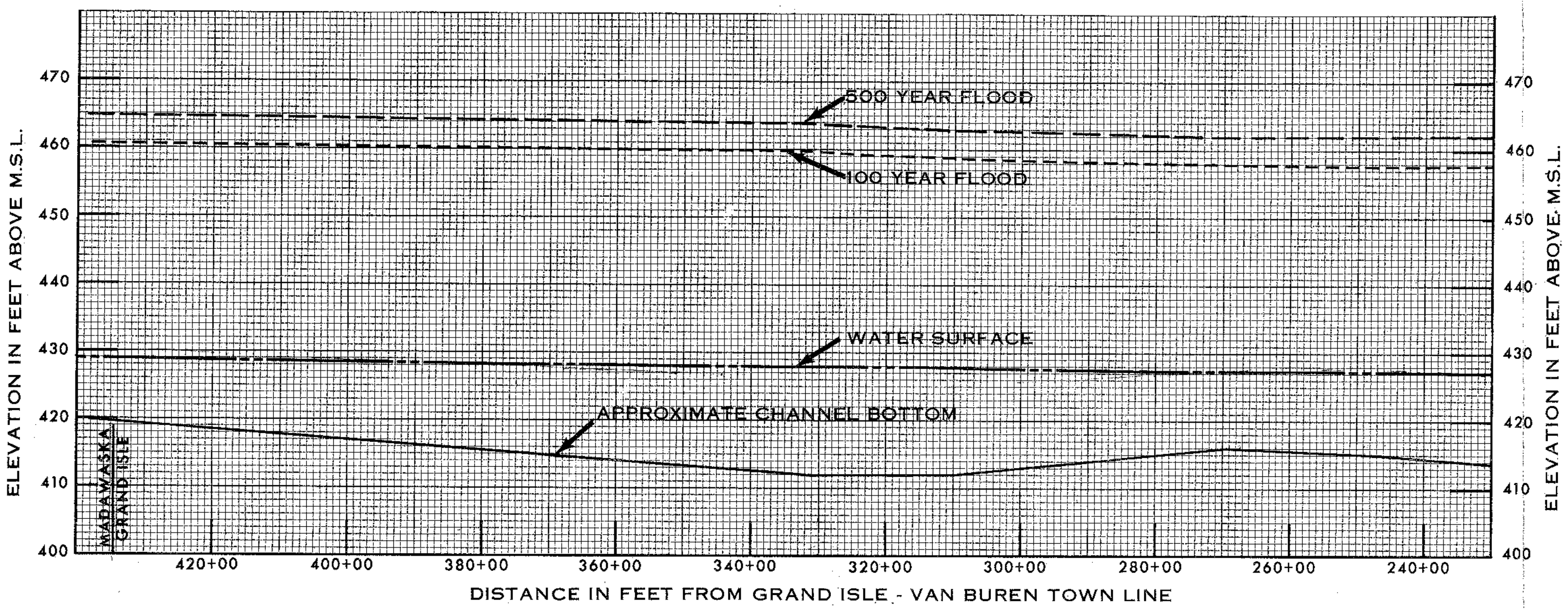
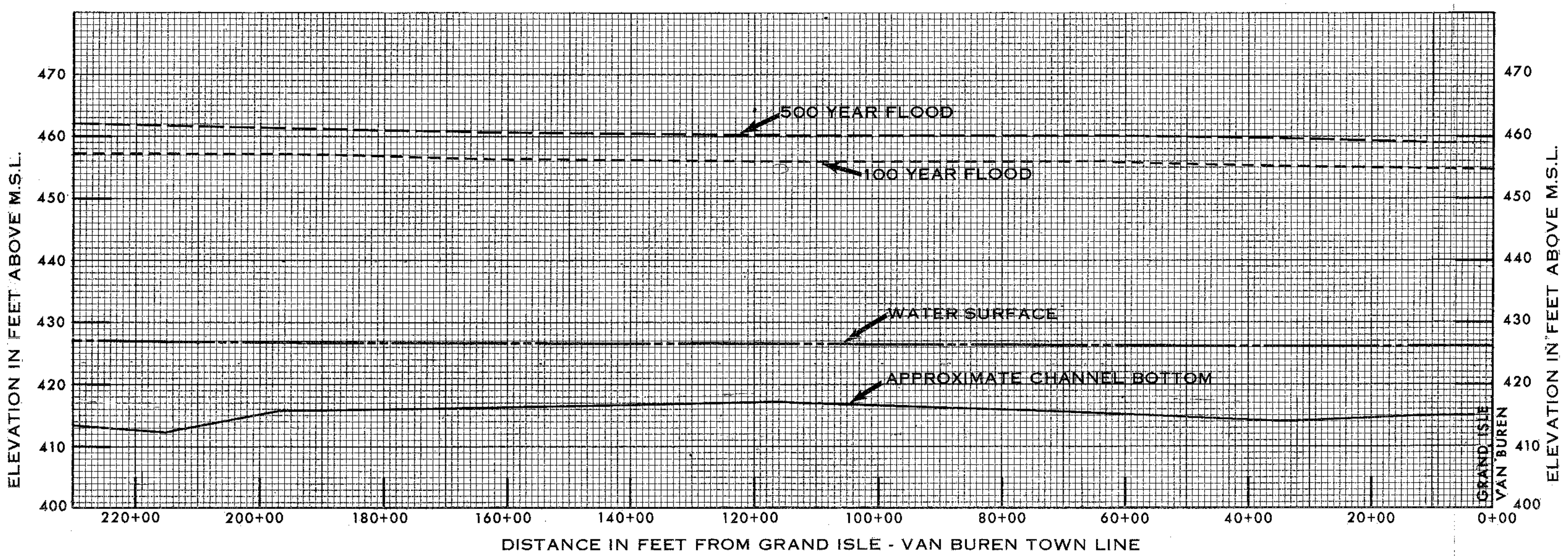
PLATE 4





LEGEND

FLOOD PLAIN INFORMATION

GRAND ISLE
MAINE
ST. JOHN RIVER

PROFILES

STA. 0+00 TO 420+00

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